TLALELETSO

Understanding ECGs

ECGs record cardiac electrical activity…

Understanding ECGs is a vital skill for all clinical practionners. By learning to understand and interpret them, clinicians will know when they need to summon expert help.

INTRODUCTION

Much in-hospital morbidity and mortality is avoidable and clinicians – nurses and doctors alike- who can recognize abnormal ECGs are well placed to improve patient outcomes.

Most ECG machines in Botswana offer diagnoses, which can provide useful advice to clinicians trying to identify acute cardiac changes in acutely ill patients. Such diagnoses are sometimes wrong and more often vague, however, and should not replace, professional analysis.

Interpretive skills are best developed by ignoring machine diagnoses and focusing solely on the graphs themselves!

In this edition of Tlaleletso we go back to basics, reviewing the fundamentals of ECG interpretation. We will review how to determine the rate, rhythm and axis as well as how to detect certain important cardiac abnormalities that require urgent intervention.

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Notes from the Editor…..

Tlaleletso is a monthly publication produced by the Botswana UPenn Partnership, in response to your expressed need for accessible, digestible clinical information.

In this first issue of 2013, we focus on understanding ECGs. This edition is specifically for **NURSES** that want to know more about how to do them and what they mean.

DID YOU KNOW?

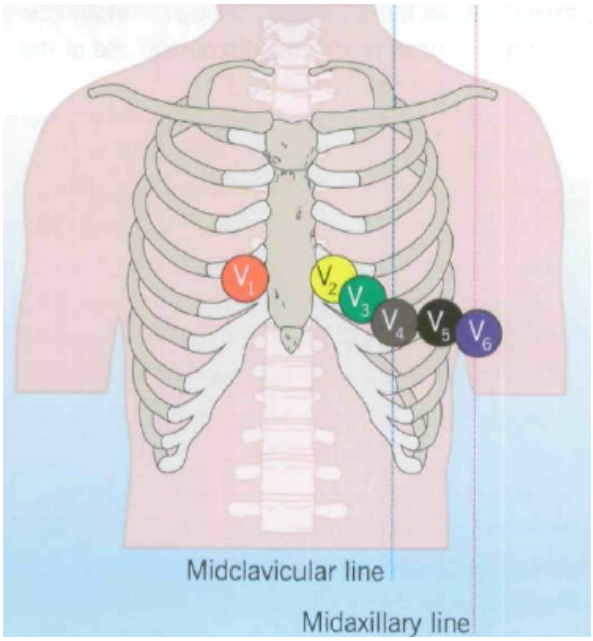
The electrocardiogram was invented by Alexander Muirhead in London in 1872, when he attached electrical wires to the wrists of a patient to try and record their heart beat.

SIMPLE STEPS TO INTERPRETING ECGs

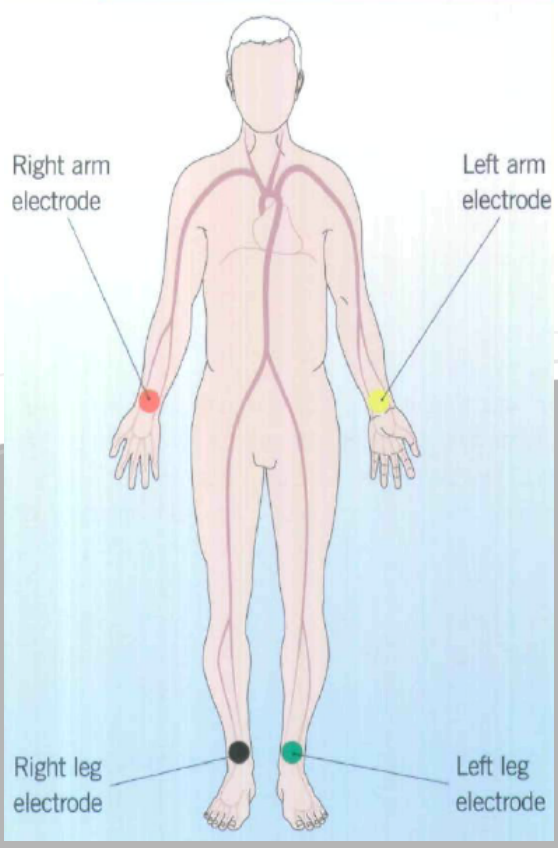
Is it regular? If so, are there P waves before every QRS and a QRS after every P wave? If so are the P waves upright in I, II and biphasic in V1 – if so then its sinus rhythm. If QRS are irregular and discrete P waves are difficult to see, it is atrial fibrillation.

What is the rate? For regular rhythms, find a QRS on a line and count the number of large boxes between it and the next one. Divide 300 by the number of boxes. Heart rates greater than 100 bpm = tachycardia; heart rates less than 60 bpm = bradycardia.

What is the axis? Mainly upright QRS in leads I and II – Normal Axis. Mainly downward in Lead I and upright in Lead II and positive V1 and V2 – Right Axis Deviation. Mainly downward in Lead II, V3 and possible V4 and upright in Lead I – Left Axis. Mainly downward in Lead I and II – Extreme right axis deviation.



LEAD PLACEMENT
The 12 lead ECG has six limb leads and six chest leads. The 6 limb leads are recorded from differently coloured electrodes on three limbs: red on the right arm, yellow on the left arm and green on the left. Together they form a triangle around the heart. In addition there is a black electrode placed on the right leg to reduce interference. There are six chest leads. To optimize electrical activity, electrodes are placed directly on the skin



PROGRESSION: Looking at a normal 12 lead ECG, count the small squares depth or height of the chest lead complexes. If progression is normal, the deepest complex from the isoelectic line should be V1 and the tallest should be V4 or V5. Abnormal chest lead progression is usually caused by axis deviation.

TROUBLE SHOOTING

Before ECGs are recorded, lead placement should be checked. All electrodes should be attached to the patient's skin. If signals fail from electrodes, they may have become faulty, for example because conduction gel has dried. If poor contact occurs, hair may have to be removed or superficial dead skin removed by gentle rubbing. Patients should be asked to lie still while ECGs are being recorded. When an ECG has printed it should be checked before the electrodes are disconnected. If some leads have failed to record or traces show electrical activity that does not originate from the heart, then the appropriate electrodes should be checked.

ATTENTION ALL NURSES:

What happens when the ECG reading does not look right!

There are many common sources of error that can lead to problems with ECG printouts. Some of the common ones are outlined below:

Electrode misplacement: Incorrect placement of electrodes should be noted on ECGs. If an ECG looks odd, especially if progression in chest leads is disrupted, recording errors should be suspected and the ECG should be repeated.

Artifact: In ECGS artifact is recorded electrical activity or deflection from the isoelectric baseline that does not originate from the heart. It usually appears as constant 'fuzz' throughout ECGs on the P waves, PR intervals, QRS complexes, ST segments, T waves and isoelectric lines between PQRST complexes. Like cardiac muscle, skeletal muscle contraction is caused by electrical activity, so any skeletal muscle movement may be detected by ECG electrodes.

When 12 lead ECGs are recorded patients are usually asked to lie still but they cannot usually control muscle tremors from shivering or conditions such as Parkinsons Disease. Artifact can also be caused by hospital equipment. There are even reports that mobile telephones can cause artifact. A different type of artifact is 'respiratory swing' which usually occurs when patients fail to hold their breath during recordings as requested and inhale immediately before the end.

Ectopics: Impulses originating from outside the patients normal pacemaker are called ectopics or extrasystoles and usually disrupt the regularity of ECGs. They may originate in the:

Atria, producing atrial ectopics or abnormal P waves but normal QRS complexes. Atrioventricular junction or node, producing junctional or nodal ectopics or no P waves and sometimes inverted P waves but normal QRS complexes.

Ventricles, producing ventricular ectopics or no p waves and wide and bizarre QRS complexes.

Ectopics may be premature, occurring before the expected bear or may be escape, occurring after the expected beat. In patients whose heart rates are erratic the timing of the ectopics usually cannot be calculated. Ectopics, especially ventricular ones, are often prominent but the underlying rhythms should be analyzed first.

Abnormal Height: Height or depth of deflection from the isoelectric baseline indicates voltage so that abnormally tall deflections indicate excessive voltage, often caused by hypertrophy.

Tall P waves indicate atrial hypertrophy, usually from chronic lung disease.

Tall QRS complexes indicate ventricular hypertrophy.

Right ventricular hypertrophy usually causes tall QRS complexes in chest leads V1 and V2, while left ventricular hypertrophy usually causes tall QRS complexes in chest leads V4 and V5. However, hypertrophy cannot be reliably diagnosed by ECG 'voltage criteria' or by the height of the QRS complexes alone.

DID YOU KNOW?
ECGs are useful for detecting abnormalities of cardiac function. But they can also help identifying lung problems – such a pulmonary embolism – and electrolyte abnormalities, like low potassium levels….

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REASONS FOR RECORDING A 12 LEAD ECG

Cardiac disease is an increasing cause of morbidity and mortality in Botswana. Twelve lead ECGs can be recorded for baseline information or in response to specific concerns. Unexplained signs and symptoms that include electrocardiography include:

- Bradycardia
- Chest pain
- Hypertension
- Hypotension
- Irregular hear rate, unless previously known about and staff are confident that no significant changes have occurred
- Palpitations
- Sudden breathlessness
- Sudden collapse
- Tachycardia

ECGs should also be recorded after any cardiac event, such as a suspected heart attached. It is not the remit of this edition of Tlaleletso to describe in detail what ECGs are present in patients who are suspected of having had an MI or 'Acute Coronary Syndrome.' This was covered in detail in Issue 4 of 2012 and can be found at the following website:

CONCLUSION

In hospitals and other healthcare settings in Botswana, ECG is an increasingly available, useful part of care. Interpreting ECGs is a skill that improves with practice. All doctors and enthusiastic nurses can develop their skills further by practicing the interpretation of ECGs encountered in clinical practice.

Upcoming Lectures

January
Complicated cases: ECGs made easy

February
HIV update: new drugs

March
Complicated cases: Diabetes

April
HIV update: PMTCT

Got a clinical question about a complicated medical patient or a patient with HIV?

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